

Geode™ GX1 Processor

National Semiconductor's Geode™ GX1 processor is specially designed to power information appliances for entertainment, education, and business. It's the perfect processor solution for IA applications such as thin clients, interactive set-top boxes, and personal Internet access devices.

Industry's Lowest Power Consumption

The Geode GX1 processor, fabricated in 0.18 micron CMOS, is available with a typical average power consumption ranging from 0.8 to 1.4 watts; making it the industry's lowest power consumption for an x86 processor at this performance level. Operating at lower voltages improves power consumption and thermal characteristics while providing maximum battery life for handheld/mobile devices. This enables maximum flexibility in system design.

Maximum Internet Compatibility

Internet access is a key feature for the latest information appliances. The Geode GX1 processor features an x86 CPU core, enabling maximum compatibility with more than 200 Web plug-ins and the widest range of software and games.

Optimized System Integration

The intelligent integration of the Geode GX1 processor features key system elements such as audio, video, and memory controller embedded directly into the silicon. This type of innovative integration improves reliability, reduces overall system costs, and enables designs with smaller form factors.

GX1 Processor Performance Characteristics				
Part Marking	Core Voltage (Vcc2)	Core Frequency	Absolute Maximum Power	Typical Power (Note) 80% Active Idle*
GX1-333P 2.2V 85C GX1-333B 2.2V 85C	2.2V (Nominal)	333 MHz	5.0W	1.4W
GX1-300P 2.0V 85C GX1-300B 2.0V 85C	2.0V (Nominal)	300 MHz	3.7W	1.2W
GX1-266P 1.8V 85C GX1-266B 1.8V 85C	1.8V (Nominal)	266 MHz	3.0W	1.0W
GX1-233P 1.8V 85C GX1-233B 1.8V 85C	1.8V (Nominal)	233 MHz	2.8W	0.95W
GX1-200P 1.8V 85C GX1-200B 1.8V 85C	1.8V (Nominal)	200 MHz	2.6W	0.8W

* Typical average power consumption is defined as an average over time, running typical browser applications, processor at 80% active idle (suspend-on-halt) with a display resolution of 800 x 600 x 8 bpp @ 75 Hz.

Processor

The computing industry is maturing from multipurpose PCs to information appliances (IAs) — application-specific devices optimized for personal information access. The emerging IA market demands flexible system solutions including proven x86 processors.

The National Semiconductor Geode GX1 processor is the first line in a new family of integrated processors featuring an ideal blend of power and performance to drive trend-setting information appliances.



Features & Benefits

Feature	Benefit
Reduced Power Consumption	Enhanced thermal characteristics enable flexible system configurations, including fanless designs.
Multiple Frequency Ranges	Enables customized systems with target level power and performance.
Proven x86 Architecture	Leverages existing infrastructure of development tools. Maximum compatibility with: <ul style="list-style-type: none">• Web plug-ins• Games• Widest array of software
Integrated System Components	<ul style="list-style-type: none">• Improves reliability• Reduces number of required parts, lowering costs• Enables designs with smaller form factors

Technical Specifications

Geode GX1 Processor

General Features

- Packaging:
 - 352-Terminal Ball Grid Array (BGA) or
 - 320-Pin Staggered Pin Grid Array (SPGA)
- 0.18-micron four-layer metal CMOS process
- Split-rail design:
 - Available 1.8V, 2.0V, or 2.2V core
 - 3.3V I/O interface
- Fully static design
- Low typical power consumption*
 - 0.8W @ 1.8V/200 MHz
 - 1.4W @ 2.2V/333 MHz

*Note: Typical power consumption is defined as an average, measured running browser at 80% active idle (Suspend-on-Halt) with a display resolution of 800 x 600 x 8 bpp @ 75 Hz.

- Speeds offered up to 333 MHz
- Unified memory architecture
 - Frame buffer and video memory reside in main memory
 - Minimizes PCB area requirements
 - Reduces system cost
- Compatible with multiple Geode I/O and graphics companion devices provided by National Semiconductor

32-Bit x86 Processor

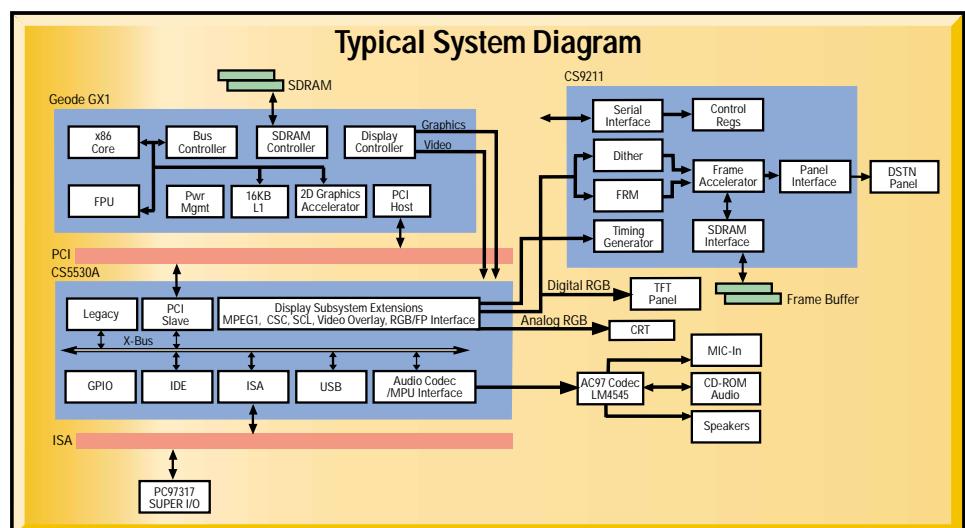
- Supports the MMX™ instruction set extension for the acceleration of multimedia applications
- 16 KB unified L1 cache
- Six-stage, pipelined integer unit
- Integrated Floating Point Unit (FPU)
- Memory Management Unit (MMU) adheres to standard paging mechanisms and optimizes code fetch performance
 - Load-store reordering gives priority to memory reads
 - Memory-read bypassing eliminates unnecessary or redundant memory reads
- Re-entrant System Management Mode (SMM) enhanced for National's Virtual System Architecture® (VSA™) technology

Flexible Power Management

- Supports a wide variety of standards
 - APM (Advanced Power Management) for legacy power management
 - ACPI (Advanced Configuration and Power Interface) for Windows power management
 - Direct support for all standard processor (C0-C4) states
 - OnNOW design initiative compliant
- Supports a wide variety of HW- and SW-controlled modes
 - Active idle (core-only stopped, display active)
 - Standby (core and all integrated functions halted)
 - Sleep (core and all integrated functions halted, all external clocks stopped)
 - Suspend modulation (automatic throttling of CPU core via Geode I/O or graphics companion chip)
 - Programmable duty cycle for optimal performance/thermal balancing
 - Several dedicated and programmable wake-up events (via Geode I/O or graphics companion chip)

PCI Host Controller

- Several arbitration schemes supported
- Directly supports up to three PCI bus masters
 - More with external logic



- Synchronous to CPU core
- Allows external PCI master accesses to main memory concurrent with CPU accesses to L1 cache

Virtual Systems Architecture (VSA) Technology

- Innovative architecture allowing OS independent (software) virtualization of hardware functions
- Provides XpressGraphics subsystem
 - High-performance legacy VGA core compatibility

Note: GUI (Graphical User Interface) acceleration is pure hardware.
- Provides 16-bit XpressAUDIO subsystem
 - 16-bit stereo FM synthesis
 - OPL3 emulation
 - Supports MPU-401 MIDI interface
 - HW assist provided via Geode I/O companion chip
- Additional HW functions can be supported as needed

2D Graphics Accelerator

- Accelerates BitBLTs, line draw, text
 - Bresenham vector engine
- Supports all 256 Microsoft-defined Raster Operations (ROPs)
- Supports transparent BLTs and page flipping for DirectDraw®
- Runs at core clock frequency
- Full VGA and VESA mode support
- Special “driver level” instructions utilize internal scratchpad for enhanced performance

Display Controller

- Display Compression Technology (DCT) architecture greatly reduces memory bandwidth consumption of display refresh
- Supports a separate video buffer and data path to enable video acceleration in Geode I/O and graphics companion chips
- Internal palette RAM for gamma correction
- Direct interface to Geode I/O and graphics companion chips for CRT and TFT flat panel support eliminating the need for an external RAMDAC
- Hardware cursor
- Supports up to 1280 x 1024 x 16 bpp

XpressRAM Subsystem

- SDRAM interface tightly coupled to CPU core and graphics subsystem for maximum efficiency
- 64-bit wide memory bus
- Support for
 - Two 168-pin unbuffered DIMMs
 - Up to 16 open banks simultaneously
 - 16-byte reads (burst length of two)
 - Up to 512 MB total memory supported

Diverse Operating System Support

- Microsoft: Windows® 2000, Windows 95, Windows 98 and Embedded NT in non-PC applications; along with Windows CE and Embedded NT
- WindRiver: VxWorks
- QNX: QNX®
- Linux™
- BIOS Support
 - Bootloaders available at no cost for rapid prototyping
 - Diverse BIOS solutions available for cost/feature optimization
 - XpressROM available through Insyde
 - Phoenix, SystemSoft, etc. solutions also available

National Semiconductor's Geode family offers a wide range of silicon and system solutions for information appliances. The Geode GX1 processor, together with the Geode CS5530A I/O Companion provides a scalable, flexible, system solution for information appliances ranging from set-top boxes to hand-held personal access devices.

The CS5530A I/O Companion works in conjunction with the Geode GX1 processor. It combines a flexible PCI-to-ISA (South Bridge) that provides complete AT/ISA functionality with a complete array of I/O resources such as Ultra IDE, USB, and General Purpose I/Os as well as an intelligent power management controller.

In addition, the CS5530A I/O Companion complements the multimedia capabilities of the Geode GX1 processor by providing back-end audio and video acceleration and directly interfacing to CRTs, TFTs, and industry standard TV encoders.

For information about the CS5530A, refer to the next page.

Technical Specifications

Geode CS5530A Companion I/O

General Features

- Designed for use with the Geode GX1 processor
- 352-Terminal Tape Ball Grid Array (TBGA) package
- 3.3V or 5.0V PCI bus compatible
- 5.0V tolerant I/O interfaces
- 3.3V core

PCI-to-ISA Bridge

- PCI 2.1 compliant
- Supports PCI initiator-to-ISA and ISA master-to-PCI cycle translations
- PCI master for audio I/O and IDE controllers
- Subtractive agent for unclaimed transactions
- PCI-to-ISA interrupt mapper/translator

AT Compatibility

- Two 8259A-equivalent interrupt controllers
- 8254-equivalent timer
- Two 8237-equivalent DMA controllers
- Boot ROM and keyboard chip select
- Extended ROM to 16 MB

Bus Mastering IDE Controllers

- Two controllers with support for up to four IDE devices
- Independent timing for master and slave devices for both channels
- PCI bus master burst reads and writes
- Ultra DMA/33 (ATA-4) support
- Multiword DMA support
- Programmed I/O (PIO) Modes 0-4 support

Power Management

- Intelligent system controller supports multiple power management standards:
 - Full ACPI and Legacy (APM) support
 - Directly manages all Geode GX1 processor power states
- I/O traps and idle timers for peripheral power management
- Up to eight GPIOs for system control
- Dedicated inputs for keyboard and mouse wakeup events

XpressAUDIO Subsystem

- Provides "back-end" hardware support via six buffered PCI bus masters
- AC97 codec interface

Display Subsystem Extensions

- Complements the Geode GX1 processor graphics and video
 - Three line buffers for video
 - YUV to RGB conversion hardware
 - Arbitrary X & Y interpolative scaling
 - Color keying for graphics/video overlay
- VDACS/display interface
 - Three integrated DACs
 - Palette RAM
 - Provides gamma correction and brightness/contrast
 - Integrated DOT clock generator
 - Digital RGB interface drives TFT panels or standard NTSC/PAL encoders

Universal Serial Bus

- One open HCI compliant controller with two ports

Geode CS9211 Graphics Companion

General Features

- Supports most SVGA DSTN panels and the VESA FPDI, revision 1.0 specification
- 18-bit color support for digital pixel input
- Supports up to 1024 x 768 panels
- 16- or 24-bit dual-scan color STN support
- 8- or 16-bit dual-scan monochrome STN support
- 8-bit single-scan color STN panel support
- TFT panel support provided by use of one connector; allows a pass-through mode for the digital pixel input
- 9-, 12- or 18-bit, 2 TFT support
- 9+9 or 12+12-bit, 2 pixels per clock TFT panel support
- Supports 64 shades of gray for each primary color for a maximum of 262,144 colors
 - Programmable Frame Rate Modulation (FRM) allows display of 32 shades of gray
 - Single bit dithering algorithm for each FRM shade of gray
- Memory controller supports SDRAM and EDO

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